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METHOD AND DEVICE FOR MONITORING THE WEAR OF A RAPIER BAND

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The invention relates to a method and a device to monitor the wear of a rapier band of a rapier loom.

Ins B2

It is known from US patent 4,982,767 to detect rapier band wear by fitting a rapier band with elements distributed across the thickness and length of this band. These elements are designed to generate optical, electrical or magnetic signals indicating the wear of the rapier band. However such elements alter the rapier band structure and therefore are not well suited in rapidly operating rapier looms.

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It is furthermore known from US patent 5,318,077 to guide the top side of a rapier band only partly in a guide block in the region of the drive wheel. Rapier band wear is determined by measuring the position of the unguided part. This kind of wear monitoring requires that part of the rapier band shall not be guided in the guide block. As a consequence the portion of the rapier band being guided in said guide block is exposed to greater wear.

The objective of the present invention is to create a method and device to monitor rapier band wear that shall be independent of specific rapier band design and/or of the guide elements.

This problem is solved by analyzing the temperature of the rapier band and/or of a component in contact with this rapier band as a characteristic value of rapier band wear.

It is the inventors' discovery that the temperature of a rapier band and also that of a component in contact with this rapier band shall change during operation as a function of this rapier band's wear. This effect is exploited to ascertain the rapier band's wear status by means of the temperature of the rapier band and/or of a component in contact with it. This monitoring method is practically independent of the configurations both of the rapier band and of the guide elements. As a consequence, the structure of the rapier band and the shape of the guide elements guiding the rapier band may be optimally designed to

accurately guide the rapier band because that particular time can be very accurately detected at which the rapier band has worn so much that the desired operation no longer can be reliably expected.

In a first embodiment of the present invention, the rapier band temperature is measured directly. Illustratively such a measurement may be carried out by an infrared detector mounted at an appropriate site. Practically however it will be adequate enough to indirectly measure the rapier band temperature. Advantageously in this case, the temperature of a component guiding the rapier band shall be measured.

In a further embodiment of the invention, the temperature differential between the rapier band temperature detected directly or indirectly and the temperature detected at a measurement site a distance away will be analyzed. As a result the ambient temperature factor shall be eliminated.

The basic task of the invention is solved using a device comprising an analyzer analyzing the temperature of the rapier band and/or of a component in contact with it as a characteristic value of this rapier band's wear.

Advantageously and in a further embodiment of the invention, a first temperature sensor detects the temperature in the immediate vicinity of the rapier band and a second temperature sensor connected to the analyzer detects the temperature at a site a distance away from the first sensor while being connected to the analyzer.

As regards a preferred embodiment, the first temperature sensor is associated with a guide block keeping the rapier band in contact with a drive wheel. This region is outside the shed and therefore easily accessed. Advantageously a thermally conducting element shall be mounted on the guide block and the first temperature sensor is affixed to an element side facing the guide block and the second temperature sensor at a side away from said block. The temperature sensors are mounted in shielded manner inside the element and therefore are very unlikely to suffer damage.

In a further embodiment of the invention, an input unit to feed a comparison value to the analyzer is associated with this analyzer. The operator may enter

through this input unit a value that shall be compared by the comparator with the detected temperature or with the monitored temperature time function, so that, when said value shall be reached, the rapier band wear shall be such that an exchange should be implemented.

In a further embodiment of the invention, the analyzer is connected to a display showing the wear status of the rapier band. Accordingly the operator is able to see or his attention may be attracted when the rapier band must be exchanged in order to assure continued optimal weaving.

Further features and advantages of the invention are elucidated in the following description of an illustrative embodiment shown in the drawings.

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Fig. 1 is a rapier-loom cutaway view with a drive wheel and equipment to monitor rapier band wear,

Fig. 2 shows a section along line II-II of Fig. 1, and

Fig. 3 shows a partial section similar to Fig. 1 of an embodiment variation.

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The portion of a rapier loom shown in Fig. 1 contains a rapier band 1 which in a manner not further shown is fitted with a rapier used to insert fillings into a shed of the rapier loom. The rapier band 1 is driven by a rocking drive wheel 2. As shown in Fig. 2, the rapier band 1 is regularly perforated and the teeth of the drive wheel 2 enter these perforations. Planar guide elements 3, 4 maintain the rapier band 1 against the periphery of the drive wheel 2 so that the teeth of the latter stay engaged with the perforations of the rapier band 1. The planar guide elements 3, 4 are configured substantially tangentially to the drive wheel 2. Said elements are mounted on supports 5, 13 which in turn are affixed by fasteners (not shown) to the rapier loom's framework.

A first temperature sensor 6 is mounted in the support 5 in the zone where the rapier band 1 is deflected from the horizontal direction into the circumferential direction of the drive wheel 2. The temperature sensor 6 is mounted in the vicinity of the guide element 3 in order to detect the temperature of latter and indirectly thereby also that of the rapier band 1.

A second temperature sensor 7 is used to eliminate the ambient temperature factor. It too is mounted in the support 5, however at a site less

affected by the temperature of the rapier band 1 or by that of the guide element 3. In this illustrative embodiment the temperature sensor 7 is situated in the uppermost and outermost corner of the support 5 that is farthest from the rapier band 1.

The support 5 housing the two temperature sensors 6, 7 is made of a material such as aluminum which is highly thermally conducting. This support 5 makes contact with the guide element 3 which is also made of a thermally conducting but wear-proof material such as steel. The heat dissipated by friction between the rapier band 1 and the guide element 3 reaches the temperature sensors 6 and 7.

The temperature sensors 6 and 7 are connected to an analyzer 8 deriving the temperature differential. A display 9 is connected to said analyzer 8 and displays for instance the temperatures picked up by the sensors 6 and 7 and their difference.

The invention is based on the discovery that, as the wear of the rapier band 1 progresses, that is as said band 1 becomes thinner, the temperature of the rapier band 1 and also that of the guide element 3 will change. This phenomenon is attributed to the position of the rapier band 1 changing relative to the guide element 3, and thereby the friction between the two also changing. The wear in such looms usually entails that the friction between the rapier band 1 and the guide element 3 will increase, hence the frictional heat also increasing. This phenomenon is exploited to monitor rapier band wear by analyzing the temperature as a characteristic value of the wear of the rapier band 1.

Sub B1

A first analytical approach consists in determining whether the rapier band 1 is everywhere thin and worn once the temperature measured by the sensor 6 exceeds a predetermined value. This value is fed through the input unit 10 into the analyzer 8. Thereupon the analyzer 8 may illustratively transmit a control signal to a control element 11 that will shut down the rapier loom in case the predetermined value has been exceeded. Moreover the control elements also may generate an alarm, for instance they may light a pilot light, to alert the operator that the rapier band 1 is worn and therefore must be exchanged. Also one or more

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~~signals may be transmitted~~ directly from the analyzer 8 to an optical or acoustic display 9.

Preferably the wear of the rapier band shall be monitored by analyzing the differential of the temperatures measured by the sensors 6 and 7. For example, the temperature differential may be monitored with respect to exceeding a predetermined value that is fed from an input unit 10 to the analyzer 8. This feature is advantageous because thereby ambient factors can be eliminated, for instance a temperature rise in the weaving room. The measured temperature differential substantially relies only on higher wear-caused friction between the rapier band 1 and the guide element 3. Therefore, regardless of the ambient temperature, this differential is indicative of the temperature of the rapier band 1 and/or of the guide element 3. Even though the temperature sensors 6 and 7 are located in the same support, they will measure different temperatures. The temperature measured by the sensor 6 essentially depends on the friction between the rapier band 1 and the guide element 3 because it is located in the immediate vicinity of that location where the frictional heat is being generated. On the other hand the temperature sensor 7 is configured at a site of the support 5 where the heat has already been substantially dissipated into ambient.

As regards the embodiment of Fig. 3, the guide element for the rapier band 1 is a guide block 12 wherein the first and second temperature sensors 6 and 7 connected to the analyzer 8 are configured in the manner of the embodiment of Figs. 1 and 2. Obviously the temperature sensors also may be configured in another way , for instance at the guide support 13 or at a guide support 14 located a distance away from the drive wheel 2.

It was found that for a new rapier band 1, the temperature measured by the sensor 6 and the temperature differential between the sensors 6 and 7 will be comparatively high. Following a run-in phase of several hours for the rapier band, the temperature or the temperature differential will decrease and assume an operational value. The temperature or the temperature differential however increase again as the rapier band wear increases. As a rule the critical value of

wear for the known rapier bands materializes following 10,000 hours or more of operation.

Furthermore the wear of a rapier band 1 also may be monitored by means of the change in time of the temperature or temperature differential. Again this change in temperature or temperature differential may be analyzed when starting a previously shutdown loom, that is, by observing how fast the temperature or the temperature differential will rise following loom start.

The invention makes it possible to substantially accurately determine when a rapier band must be replaced. As a result the rapier band may be used as long as intrinsically feasible. This feature furthermore is advantageous over the procedure whereby every rapier band must be replaced following a given time of operation. The invention allows detecting in due time a prematurely worn rapier band and to prevent its rupture. Again a rapier band that incurs less wear than typical may be used for longer operational times than prescribed by scheduled replacements.

The invention is not restricted to the above illustrative embodiments. In particular the temperature or the temperature differential may be measured in ways that are different from above, for instance at other sites or using different sensors, such as infrared detectors. The scope of protection of the present invention is solely defined by the attached claims.